

Using Soar to Create Individualized Learning Experiences

Bob Wray
20 May 2010
Soar 30 Workshop



Individualized Learning

- The National Academy of Engineering has identified “personalized learning” as one of 10 grand challenges for the new millennium
 - “Approximate the effect of the best teaching”
 - Adapt to individual learner’s
 - Demonstrated conceptual and skill learning
 - Motivational needs
 - Individual strengths and weaknesses
- Many ways to go about personalization...

Dynamic tailoring for learning

- Adjust state, behaviors, and feedback signals on the fly to promote learning
 - be more/less accepting of errors
 - increase/decrease level of explanatory content in domain feedback
 - make action feedback less/more subtle
 - increase/decrease difficulty
- Filter & adjust the game interface
 - reveal/hide selection items (i.e., filter options available to learner)
 - highlight certain actions over others
 - Emphasize changes in game state
- Intrinsic adaptation
- Extrinsic mediation

Purposes and mechanisms for tailoring

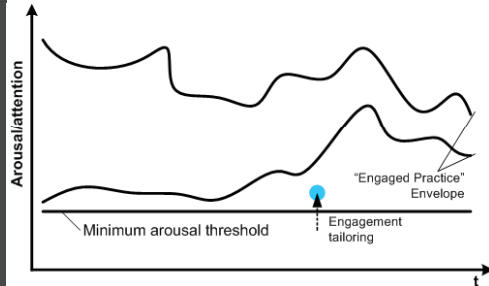
- Scaffold
 - support observed deficits in student knowledge
- Fade
 - remove scaffolding as student acquires knowledge
- Challenge
 - difficulty/complexity control
- Engage
 - manage attention, stress, or motivation
- Individualize
 - adapt to learner differences
- Outcome manipulation
 - modify effects of a student action
- Character manipulation
 - adjust content and/or delivery of character actions/speech
- Input manipulation
 - limit or expand the options available to the learner
- Event manipulation
 - adjust simulation to provide specific experience
- Gameplay manipulation
 - adjust interface and/or game mechanics

Example: Engagement Tailoring

Attention to the learning experience as important as the learning content

Engagement tailoring

- Attempt to bring student attention back to narrative
 - “Intervene before bored”



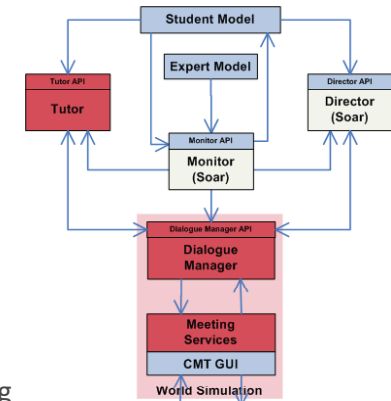
- Example Approach: Character “challenge”
 - Character speaks “out of turn”
 - “Surprise” the student with an unexpected interaction
- Character response is dependent on the student’s experience
 - Novice: friendly
 - “Would you like some tea?”
 - Advanced: More challenging
 - “You seem pre-occupied. Should we continue at another time?”

Commercial sensors are increasingly available to provide deployable solutions for measuring arousal and other cognitive states...

5

Tailoring “under the hood”

- General s/w architecture
- Learner/Domain Models
 - Expert Model
 - “Student” model
 - Action assessment
 - Skill/proficiency
- Monitor (Soar)
 - Track student action
 - Compare to model
 - Update proficiency model
 - (See Soar 29 Talk)
- “Director” (Soar)
 - Intrinsic adaptation/tailoring
 - Many tailoring methods
 - Alternative educational strategies



6

Components of the Student Model

Expert model:

- Generation of “good” actions
- Used to recognize errors & define challenges

Assessment Model:

- Dynamic assessment of student status within the current situation. Enables system to:
 - Categorize errors & map to relevant LOs
 - Support on-going diagnosis

Skill model: Assess individual LOs

- Integrative view of mastery of LO over time
- Proficiency used as an input for selection of tailoring strategies
 - Individual learning objectives
 - Aggregate view of student proficiency

7

Pedagogical action categories

- Helpful:
 - provide support to the learner
- Predictable:
 - actions should produce expected results
- Unpredictable:
 - actions may or may not produce expected results
- Unhelpful:
 - withhold support to the learner
- Wanted tailoring agent to keep tailoring strategy distinct from the learner’s estimated proficiency
 - Novice → Helpful & Predictable (Scaffold approach)
 - Novice → Unhelpful & Unpredictable (Challenge to learn)

8

Employing the “classic” Soar design patterns

- The tailoring agent employs “classic” Soar design patterns to solve multiple representational goals:
- Customizing for alternate educational strategies
 - Name the strategy
 - Create elaborations dependent on strategy (contextual view of pedagogical situation)
 - Proposals for methods dependent on contextual cues
- Scaling (Alternative strategies, many methods)
 - Represent rationales for strategy (operator proposals)
 - Represent applications of strategy (operator applications)
 - Reason about competing strategies (tie; selection space)
 - Large knowledge-base, cheap, fast match

Summary

- Dynamic tailoring a potentially important tool for individualizing student experience/learning
- Have now created a general s/w architecture for dynamic tailoring
 - Deliver a wide range of tailoring methods under alternative educational assumptions
- Soar’s “tried and true” design patterns make it trivial to customize and scale
- Soar 9?
 - Better-integrated models
 - Learning vs. hand-tuning
- Validation Evaluation
 - What are specific payoffs to the learner?
- BASF Challenge